PRA Technical Adequacy to Support Implementation of the Mitigating Systems Performance Index for the Reactor Oversight Program

Introduction

For many years the NRC has adhered to a policy that PRA technical adequacy must be commensurate with the application under consideration. That is, the rigor of the PRA input supporting a decision must increase with the magnitude or degree of change sought by the application. For example, in an application like the proposed 10 CFR 50.69, where the PRA is used to support a categorization process that may remove many safety-related, low safety-significant components from the scope of ten different regulations governing treatment, the PRA must be of high quality and is a requirement of the rule itself.

The MSPI has been piloted as a replacement for the Safety System Unavailability (SSU) performance indicators (PIs) in the current ROP. There are no changes to any regulations or regulatory requirements associated with MSPI replacing SSU. The purpose of all 18 PIs in the current ROP is to provide an indication of licensee performance that NRC uses to allocate its inspection resources beyond the baseline inspections that all plants receive. This purpose is not altered by MSPI.

The principal difference between MSPI and SSU in implementation is that under the current ROP, the NRC staff employs the significance determination process (SDP) to evaluate failures of single components within the mitigating systems covered under SSU. In the current process, the NRC and licensee can discuss the adequacy of the PRA to characterize the significance of a failure and arrive at a mutual agreement. Under MSPI, the index is designed to provide an indication of the safety significance of single failures within these systems, and use of the SDP would be unnecessary. Thus, without the opportunity for discussion that use of the SDP provided, the question raised is what level of PRA adequacy is needed to support MSPI in terms of depicting the safety significance of single failures. The purpose of this paper is to address this question.

Industry Peer Reviews

By November 2003, all operating nuclear plants in the U.S. will have been peer reviewed by an independent team of reviewers. Members of the NRC staff, ACRS staff, and a public interest group have participated as observers in selected peer reviews. In DG-1122, the NRC has endorsed the industry peer review process as a means of meeting the peer review requirement in the ASME Level I PRA Standard RA-S-2002. The peer reviews provide an assessment of a licensee's PRA against accepted industry practice for the technical elements and methods that make up the PRA. Licensees use the results of the peer reviews to target improvements to their plant-specific models. Most of these improvements have already been implemented

by licensees. Any remaining deficiencies can be assessed for their impact on the MSPI application and resolved before MSPI is incorporated into the ROP.

Pre-MSPI Implementation Activities

The MSPI pilot program was conducted at 20 nuclear units. Draft guidance on implementing MSPI was tested by the pilots and the results were carefully evaluated by the industry and NRC staff. Several technical issues were raised, solutions proposed and tested, leading to agreements on the appropriate resolutions. The implementation guidance for the ROP, NEI 99-02, will be revised to reflect the experience gained in the pilot program.

The industry is planning several workshops to help licensees establish their MSPI programs. The workshops will include NRC participation, including regional and resident staff, to ensure there is common understanding and agreement on the elements of the program. These elements include proper scoping and selection of the components to be monitored in each system, the success criteria for those components, and the importance measures used in the licensee's PRA to characterize the safety significance of those components. Thus, there will be ample opportunity for licensees and their NRC counterparts to discuss and reach agreement on the PRA elements used to support the MSPI application prior to industry-wide implementation. This interaction will be similar to the PRA discussions that occur when the SDP is being conducted.

Comparison to Maintenance Rule Application

Plant PRAs have been applied to help establish equipment performance criteria required by the maintenance rule, 10 CFR 50.65. Baseline inspections of maintenance rule implementation included use of PRAs in this application, which were found acceptable. The MSPI application is analogous to the maintenance rule application in terms of the methods used to monitor performance and establish performance criteria. In the maintenance rule, the performance criteria are used to identify deviation from acceptable levels of performance for maintenance rule systems. When these levels are not met, the licensee is required to take measures to correct the degradation in performance. In MSPI, failure to meet the established criteria causes the NRC to take additional action, i.e., conduct additional inspection. Thus, the only significant difference is the party triggered to action by the degradation in performance.

Improved Consistency with NRC SPAR Models

The pilot program also compared the pilot plant PRA models with the NRC's SPAR models to verify risk model importance measures at the component level. The result was that additional efforts were necessary to enhance the SPAR models to

more accurately reflect plant designs. Once the enhancements were completed, MSPI results using the pilot plant models and the SPAR models achieved a high degree of consistency. Numerical results generally agreed within a factor of three for values greater than 1E -7. While this verification effort for the MSPI application does not serve to validate the technical adequacy of the entire plant PRA, it does provide added confidence that there are no major systematic deficiencies in the MSPI submittals for pilot plants.

The NRC's Office of Research is following up the pilot verification effort with some additional assessments of modeling differences on MSPI results. The results of this activity will be factored in to the pre-MSPI implementation activities.

What are the Consequences of an Error?

Despite the efforts described above that provide confidence that PRA's are technically adequate to support the MSPI application, there will always be some potential for model error that may generate non-conservative results. An example could be a component failure in one of the monitored systems. Because of a modeling error, the failure does not result in an index value that crosses the 1E-6 green/white threshold. Thus, the indicator remains green when the valid indication would be white. In this case, the indicator would not trigger the NRC to conduct additional inspection in this area (8 to 40 hours).

The component failure, however, would be required to be entered into the licensee's corrective action program, which is included in the NRC's baseline inspection program. In addition, the failure would be a functional failure in the licensee's maintenance rule program, also requiring corrective action and potential goal setting per 10 CFR 50.65(a)(1). Finally, the failure would likely cause entry into the associated limiting condition of operation of the licensee's technical specifications. Thus, there are three different regulatory requirements that would address this failure, drawing the requisite licensee and regulatory attention and resources. Given these elements, there is little question that the failure would be adequately addressed, even without the additional inspection hours that the indicator would trigger.

Conclusion

The combination of industry peer reviews of all plant PRAs, pre-MSPI implementation activities, and NRC SPAR model verification efforts provide a high degree of confidence that licensee PRA models are adequate to support MSPI implementation. In addition, current regulatory requirements ensure that any potential errors in the PRAs that support MSPI do not result in unacceptable consequences, i.e., have no effect on public health and safety.